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The Essential Oil of the Genus *Brachanthemum* from Mongolia

S. Shatar*
Institute of Chemistry and Chemical Technology, Mongolian Academy of Science. Ulaanbaatar-51, Mongolia
R.P. Adams
Baylor University, Biology Department, P.O.Box 727, Gruver, TX 79040 USA
M. Todorova
Institute of Organic Chemistry with Centre of Phytochemistry, Bulgarian Academy of Science. 1113. Sofia, Bulgaria

Abstract

The essential oil of the leaves of *Brachanthemum gobicum* Krasch., *B. mongolicum* Krasch. and *B. mongolorum* Grub. were investigated by GC and GC/MS. The clear essential oil of *B. gobicum* was dominated by 1,8-cineole (42.6%) and camphor (29.1%) with moderate amounts of camphene (6.1%), α-pinene (2.5%), p-cymene (1.8%), terpinen-4-ol (1.8%) and *cis*-sabinene hydrate (1.3%). The oil of *B. mongolicum* had an abundance of camphor (39.5%) and 1,8-cineole (20.2%) and with moderate amounts of camphene (11.5%), borneol (9.5%), bornyl acetate (4.1%), *cis*-thujone (1.9%), α-pinene (1.3%) and p-cymene (1.1%). The major constituents of the blue oil of *B. mongolorum* were chamazulene (18.3%) and 1,8-cineole (14.6%) followed by (β)-caryophyllene (7.2%), germacrene D (5.4%),dehydro-1,8-cineole (4.5%), p-cymene (3.8%), (E)-β-ocimene (3.6%), caryophyllene oxide (2.7%) and limonene (2.3%).

Key Word Index

Brachanthemum gobicum., *Brachanthemum mongolicum.*, *Brachanthemum mongolorum.*, *Asteraceae*, essential oil composition, camphor, chamazulene, 1,8-cineole.

*Address for correspondence: sshatar@yahoo.com

Rec: April 2008
Rev: June 2008
Acc: September 2008

1041-2905/10/0005-0409$14.00/0—© 2010 Allured Business Media

Introduction

Brachanthemum is a scarcely studied genus with ten central Asian and Chinese species according to Mabberley (1). In Mongolia, the genus *Brachanthemum* Krasch. is represented by three species: *B. gobicum* Krasch., *B. mongolicum* Krasch., and *B. mongolorum* Grub (2). The essential oils of the genus have not received much attention. Shatar (3.4) made an oral report on the oil of *B. gobicum* along with related species and in their investigation reported quaiol (12.4–31.6%), camphor (5.6%) and terpinen-4-ol as major constituents of the resin oil from the stems of *Brachanthemum gobicum* from Mongolian Gobi. Shatar and Adams (5) analyzed the blue oil of *B. mongolorum* and reported 13.2% chamazulene, plus large amounts of 1,8-cineole (14.7%) and camphor (8.5%), with moderate amounts of germacrene D (6.3%), β-caryophyllene (6.2%), borneol (4.3%), myrcene (3.8%), (E)-β-ocimene (2.8%), p-cymene (2.7%), caryophyllene oxide (2.5%) and limonene (2.0%). However, the analysis was based on total ion counts (TIC) on a Finnigan Ion Trap machine (5). No analysis of the essential oil of *B. mongolicum* was found in the open literature.

Khanina et al (6) identified 47 components in the oil of *B. baranovii (Krasch ex Poljak)* Krasch. from Russia's Central Altair mountains. Tsevelev (7) reported the major components of *B.baranovii* as 1.8-cineole (23.9%), camphor (17.3%), terpinen-4-ol (13.6%), γ-terpinene (5.4%) and α-terpineol (2.6%).

The purpose of this paper is to compare the essential oils of all three of the Mongolian *Brachanthemum* species utilizing analyses on an HP MSD spectrometer with quantitation by FID.

Experimental

Plant material: Plant material was collected from native plants of *B. gobicum* in the middle Gobi-Tsagaan Suvraga, *Adams/Shatar 7524, 7525, 7605; B. mongolicum* in the Dzungarin Gobi in the Baitag Bogd-Ula mountains, *Adams/Shatar 7606*; and *B. mongolorum* in the Tsog Undur-Ula mountains of eastern Mongolia, *Adams/Shatar 7521, 7522, 7523*. Voucher specimens have been deposited at the herbarium of the Institute of Botany of the Mongolian Academy of Science. Ulaanbaatar-51, Mongolia.

Isolation of oils: Air dried leaves (200 g) were water-distilled for 2 h using a circulatory Clevenger-type apparatus (8). The oil samples were concentrated (diethyl ether trap removed) with N_2 and the samples stored at -20 °C until analyzed. The exhausted leaves were oven dried (48 h at 100 °C) for determination of oil yields (0.32–0.6 mL).

Analyses: Oils from each of the taxa were analyzed and average values were reported. The oils were analyzed on a HP5971 MSD mass spectrometer, scan time 1 sec., directly coupled to a HP 5890 gas chromatograph, using a J&W DB-5, 0.26 mm x 30 m, 0.25 micron coating thickness, fused silica capillary column. The column was programmed from 60–240°C at 3°C/min. Identifications were made by library searches of the authors' volatile oil library (9), using the HP Chemstation library search routines, coupled with retention time data of authentic reference compounds. Quantitation was by FID on an HP 5890 gas chromatograph using a J&W DB-5, 0.26 mm x 30 m, 0.25 micron coating thickness, fused silica capillary column, programmed under the same conditions as above using the HP Chemstation software.

Results and Discussion

The clear essential oil of *B. gobicum* (from two sites in the Gobi desert) was dominated by 1,8-cineole (39.1%, 42.6%) and camphor (27.4%, 29.1%) with moderate amounts of camphene (3.4%, 6.1%), α-pinene (1.4%, 2.5%), p-cymene (3.4%, 1.8%), terpinen-4-ol (2.5%, 1.8%) and *cis*-sabinene hydrate (0.5%, 1.3%). The oil of *B. mongolicum* was clear and similar to *B. gobicum* in having an abundance of camphor (39.5%) and 1,8-cineole (20.2%) and moderate amounts of camphene (11.5%), α-pinene (1.3%) and p-cymene (1.1%). However, the *B. mongolicum* oil differed from *B. gobicum* in having moderate amounts of borneol (9.5%), bornyl acetate (4.1%), α-thujone (1.9%) and β-thujone (0.5%) and *cis*-chrysanthenyl acetate (0.5%). The major constituent of the blue oil of *B. mongolorum* was chamazulene (18.3%) giving the oil its bright blue color. The second major constituent of the oil was 1,8-cineole (14.6%) followed by β-caryophyllene (7.2%), germacrene D (5.4%),dehydro-1,8-cineole (4.5%), p-cymene (3.8%), (E)-β-ocimene (3.6%), caryophyllene oxide (2.7%) and limonene (2.3%). It is noticeable that the oil of *B. mongolorum* was rich in many minor sesquiterpenes not found in either *B. gobicum* or *B. mongolicum*. All results can be seen in Table I.

This report utilizing FID data for B. *mongolorum* is similar to the previous report (3) based on Ion Trap TIC (ITTIC) data. For example, comparing FID vs. ITTIC (from 3): chamazulene (18.3%, 13.2%), 1,8-cineole (14.7%, 14.7%), camphor (10.0%, 8.5%), β-caryophyllene (7.2%, 6.2%), germacrene D (5.4%, 6.3%) and caryophyllene oxide (2.7%, 2.5%). However, this is not always the case for FID and ITTIC data.

These data from essential oils support a close relationship between *B. gobicum* and *B. mongolicum* with *B. mongolorum* being about equally separated from the other two taxa.

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Table I. Composition of the leaf oils of *Brachanthemum gobicum*, *B. mongolicum* and *B. mongolorum* from Mongolia

RI	Compound	*B.gobicum*		*B.mongolicum*	*B.mongolorum*	*B.Baranovii [6,7]*
846	(E)-2-hexenal	-	0.2	0.1	t	-
906	santolinatriene	-	-	0.1	-	-
921	tricyclene	0.2	0.3	0.6	t	t
924	α-thujene	0.4	0.3	0.1	0.2	0.1
932	α-pinene	1.4	2.5	1.3	0.6	0.2
946	camphene	3.4	6.1	11.5	1.3	0.7
959	heptanol	-	-	0.1	-	-
960	isoamyl propionate	-	-	0.3	-	-
969	sabinene	0.3	1.0	0.3	0.9	0.9
974	1-octen-3-ol	-	-	-	t	0.1
974	β-pinene	0.7	1.2	0.8	0.7	0.2
981	6-methyl-5-hepten-2-one	-	-	t	-	-
988	myrcene	-		0.4	4.5	-
988	dehydro-1,8-cineole	0.6	0.7	-	-	0.5
1002	α-phellandrene	t	0.1	-	0.1	-
1007	isoamyl isobutyrate	-	0.2	0.2	-	-
1011	2,3,4-trimethyl pentane*	-	0.7	0.3	-	-
1014	α-terpinene	0.7	0.8	t	0.3	2.8
1020	p-cymene	3.4	1.8	1.1	3.8	1.6
1024	limonene	-	-	-	2.3	-
1026	1,8-cineole	39.1	42.6	20.2	14.6	23.9
1032	(Z)-β-ocimene	-	-	-	0.7	-
1044	(E)-β-ocimene	-	-	-	3.6	-
1049	amyl isobutyrate	-	-	t	-	-
1052	isoamyl butyrate	-	-	t	-	-
1054	γ-terpinene	0.4	1.2	0.4	1.7	5.4
1065	*cis*-sabinene hydrate	0.5	1.3	0.2	1.1	0.5
1080	artemisia alcohol	-	t	t	-	-
1086	terpinolene	-	0.3	t	0.2	1.3
1095	linalool	0.1	-	-	0.8	0.4
1098	*trans*-sabinene hydrate	0.2	1.0	0.2	0.8	-
1100	isoamyl 2-methylbutyrate	-	0.2	0.2	-	-
1100	2-methylbutyl 2-methylbutyrate	0.7	0.6	0.1	-	-
1100	n-nonanal	-	-	-	0.4	-
1101	α-thujone (=*cis*-thujone)	t	-	1.9	-	-
1103	2-methylbutyl isovalerate	-	0.1	t	-	-
1112	β-thujone (=*trans*-thujone)	0.9	-	0.5	-	-
1118	*cis*-p-menth-2-en-1-ol	t	0.4	0.1	-	-
1122	α-campholenal	-	-	0.1	-	-
1124	chrysanthenone	-	-	0.1	-	0.2
1127	aromatic terpene, FW 150, 41,69,81,135	-	-	0.7	-	-
1141	camphor	27.4	29.1	39.5	10.0	17.3
1160	pinocarvone	-	0.4	0.5	-	-
1165	borneol	0.4	0.8	9.5	4.8	-
1174	terpinen-4-ol	2.5	1.8	0.6	1.4	13.6
1179	p-cymen-8-ol	0.8	t	-	-	-
1186	α-terpineol	2.7	1.4	0.2	1.8	2.6
1194	myrtenol	0.2	0.1	0.1	-	0.2
1195	*cis*-piperitol	0.1	0.1	-	-	0.3
1227	*cis*-p-mentha-1(7),8-dien-2-ol	-	0.1	-	-	-
1234	ascaridole	-	0.1	-	-	0.1
1235	neral	-	-	-	-	
1261	*cis*-chrysanthenyl acetate	0.2	-	0.5	-	-
1264	geranial	-	-	-	0.1	-
1284	bornyl acetate	-	-	4.1	-	0.1
1288	lavandulyl acetate	-	-	0.4	-	-
1299	terpinen-4-yl acetate	-	0.1	0.2	-	0.2
1316	δ-terpinyl acetate	1.3	0.1	t	-	-
1346	α-terpinyl acetate	0.2	0.6	0.5	-	1.1
1373	α-ylangene	-	-	-	0.3	-
1374	α-copaene	0.1	0.1	-	-	0.3
1379	geranyl acetate	-	-	t	-	-
1383	isobornyl propionate	-	-	t	-	-
1387	β-bourbonene	-	-	-	0.5	-

Table I. Continued

RI	Compound	*B.gobicum*		*B.mongolicum*	*B.mongolorum*	*B.Baranovii [6,7]*
1417	β-caryophyllene	0.2	-	-	7.2	0.2
1452	α-humulene	-	-	-	0.5	0.1
1454	(E)-β-farnesene	-	-	-	0.4	-
1481	γ-curcumene	-	-	-	1.2	-
1484	germacrene D	-	0.2	-	5.4	2.4
1489	β-selinene	-	0.3	-	1.0	-
1493	zingiberene	-	-	-	0.9	-
1500	bicyclogermacrene	-	-	-	0.7	1.1
1508	germacrene A	-	-	-	0.2	-
1521	β-sesquisphellandrene	-	-	-	0.3	-
1577	spathulenol	1.2	-	-	1.0	1.5
1582	caryophyllene oxide	-	-	-	2.7	-
1587	davanone	0.2	0.2	-	-	-
1607	(Z)-sesquilavandulol	-	-	-	0.4	-
1674	α-bisabolol	-	-	-	0.3	-
1685	germacra-4(15),5,10(14)-trien-1-al	-	-	-	0.5	-
1730	chamazulene	-	-	-	18.3	-
1983	5,6-dihydrochrysene*	-	-	-	0.2	-
2100	henelcosane	-	-	-	0.3	-
2300	tricosane	-	-	-	0.6	-

s Gobi = south side of Gobi desert, m Gobi = middle region of Gobi desert. RI = Arithmetic index on DB-5(= SE54) column. *Tentatively identified. Compositional values less than 0.1% are denoted as traces (t). Unidentified components less than 0.5% are not reported. Those compounds that appear to distinguish taxa are in boldface.

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